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STATEMENT OF VERIFICATION

I, Akio Shionoiri, of Fujisawa Central Bldg. 6F, 1-4, Kugenuma-Tachibana 1-chome, Fujisawa-shi, Kanagawa 251-0024 Japan, hereby declare that I am the translator of the documents attached, and certify that the following is a true English translation to the best of my knowledge and belief.

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[Document Name] Specification

[Title of the Invention] Drainage System

[Claims]

[Claim 1]

A drainage system for carrying out processes for suction discharge a solution from a vessel through a suction nozzle comprising;

support means for supporting the suction nozzle for movement toward the vessel; and

suction nozzle moving means including urging means for urging the suction nozzle toward the vessel,

the suction nozzle moving means being capable of positioning the suction nozzle with the distal end thereof in contact with the inner wall surface of the vessel.

[Claim 2]

A drainage system for carrying out processes for suction discharge a solution from a vessel through a suction nozzle comprising;

a magnet particle holding means; having

a magnet, and

magnet moving means for supporting the magnet so as to be movable toward and away from the vessel,

the magnet being capable of holding magnetic particles in a given position in the vessel by being moved toward the vessel by the magnet moving means.

[Claim 3]

A drainage system for carrying out processes for suction discharge a solution from a vessel through a suction nozzle comprising;

a plurality of suction nozzles;

a branch manifold connected to the suction nozzles through pipes;

a suction pump for suction from the suction nozzles through the branch manifold; and

liquid conveying means for feeding a liquid into the pipes between the branch manifold and each of the suction nozzles, thereby filling the pipes with the liquid,

the liquid conveying means being capable of operating so that the solution in the vessel can be sucked out simultaneously from the suction nozzles through the branch manifold.

[Claim 4]

A drainage system for carrying out processes for suction discharge a solution from a vessel through a suction nozzle comprising;

support means for supporting the suction nozzles for movement toward the vessel;

suction nozzle moving means including urging means for urging the suction nozzles toward the vessel;

a magnet particle holding means; having

a magnet, and

magnet moving means for supporting the magnet so as to be movable toward and away from the vessel;

a branch manifold connected to the suction nozzles through pipes;

a suction pump for suction from the suction nozzles through the branch manifold; and

liquid conveying means for feeding a liquid into the pipes between the branch manifold and each of the suction nozzles, thereby filling the pipes with the liquid,

the suction nozzle moving means being capable of

positioning the suction nozzle with the distal end thereof in contact with the inner wall surface of the vessel,

the magnet being capable of holding magnetic particles in a given position in the vessel by being moved toward the vessel by the magnet moving means, and

the suction pump being capable of operating so that the solution in the vessel can be sucked out simultaneously from the suction nozzles through the branch manifold.

[Detailed of the Invention]

[Field of the Invention]

[0001]

The present invention relates to a drainage system for carrying out treatments that are required in predetermined processes for reagent addition, liquid suction, discharge, and separation, etc., using a vessel.

[Description of the Prior Art]

[0002]

[Description of the Prior Art]

In the fields of clinical chemistry, biochemistry, pharmaceutical chemistry, etc. that involve chemical analyses, various treatments, such as reagent addition, liquid suction, discharge, and separation, etc., are carried out in reaction processes. In the case where a liquid sample in a vessel, such as a micro-plate assembly or vial, contains an objective substance, for example, magnetic particles that serve to hold the objective substance on their respective surfaces are loaded into the liquid sample. After the objective substance is held on the magnetic particles, supernatant liquid is sucked out and discharged, whereby the objective substance can be separated from the liquid

sample.

In this treatment, only the supernatant liquid is sucked out and discharged while the magnetic particles that hold the objective substance are not discharged. For this purpose, a magnet is brought close to the vessel to collect the magnet particles in one place.

[0003]

[Problems to be solved by the Invention]

A conventional treatment such as separation treatment using magnet particles is carried out by manual operation or by using suction mechanism provided with a plurality of plungers.

A conventional treatment such as manual separation requires troublesome operations, such as operation for bringing the magnet close to the vessel and operation for discharging supernatant liquid by a pipette or the like. In the case where a large number of minute vessels, such as micro-plates, vials, etc., are arranged for the treatment, the treatment takes a long time.

[0004]

On the other hand, a system in which a suction mechanism with a plurality of plungers are used for automatic separation requires an actuator that entails high-accuracy control for each plunger, in order to actuate a plurality of micropipettes by the plungers. Thus, the system is complicated and expensive.

[0005]

Then, this invention solves the above mentioned conventional problems. The object of the present invention is to provide a drainage system capable of carrying out processes for suction, discharge, separation, etc. with use of a simple mechanism.

[0006]

[Means for solving the problem]

In the system for carrying out processes for sucking and discharging a solution from a vessel, the present invention comprises a suction nozzle moving means for positioning the tip of a suction nozzle automatically in the state of contact on the wall surface in a vessel, a magnetic particle holding means for holding the magnetic particle in a vessel automatically in the predetermined location in a vessel, a solution discharge means to suck and discharge a solution through a plurality of suction nozzle from the inside of a vessel. The present invention having such means mentioned above can perform processing for suction, discharge, separation, etc., automatically with use of a simple mechanism, and one or combination of each means can constitute a drainage system.

[0007]

This first aspect of the invention automates processing with a suction nozzle moving means, and the suction nozzle moving means comprises a support means for supporting a suction nozzle movable toward a vessel and a urging means to urge the suction nozzle toward a vessel. The suction nozzle is urged toward the vessel by the urging means, and the support means supports the suction nozzle for movement. If the support means is further moved toward the vessel after the suction nozzle touches the inner wall surface of the bottom portion of the vessel, therefore, the nozzle end can be kept in contact with the inner wall surface of the bottom portion. In this state, the suction nozzle sucks and discharges the solution from the vessel. In separating the suction nozzle from the vessel after the solution is sucked and discharged, the nozzle, which is urged toward the vessel by the urging means, is allowed automatically to return to its initial

position.

[0008]

Thus, with use of the suction nozzle moving means, the suction nozzle can be positioned automatically on the bottom portion of the vessel without requiring positioning control for the suction nozzle. Further, the residual quantity of the solution can be reduced by positioning the suction nozzle on the bottom portion of the vessel.

[0009]

A drainage system in the second aspect of the invention automates processing with a magnetic particle holding means, and includes a magnet and a magnet moving means for supporting the magnet so as to be movable toward and away from a vessel.

If the magnet is brought close to the vessel by the magnet moving means, in this second aspect of the invention, the magnetic particles that hold an objective substance in the vessel are automatically collected on the inner wall surface of the vessel. The position in which the magnetic particles are collected is settled depending on the position where the magnet is brought close to the vessel. Only the solution in the vessel can be sucked out by shifting the distal end position of the suction nozzle from the position where the magnetic particles are collected.

An example of the magnet moving means may be provided with an eccentric cam such that the magnet can be moved toward and away from the vessel by displacing the magnet toward the vessel by the cam.

[0010]

A drainage system in the third aspect of the invention automates processing with solution discharge means for sucking and

discharging the solution simultaneously from the vessel through a plurality of suction nozzles. The solution discharge means includes a branch manifold connecting the suction nozzles individually to branch ends by pipes, a suction pump for suction from the suction nozzles through the branch manifold, and liquid conveying means for feeding a liquid into the pipes between the branch manifold and each of the suction nozzles, thereby filling the pipes with the liquid.

In this third aspect of the invention, suction of solution by one suction pump through a plurality of suction nozzles is realized by connecting those suction nozzles to a branch manifold. Further, by filling the pipes between the branch manifold and each of the suction nozzles with the liquid by the liquid conveying means, the solution in the vessel can be sucked and discharged simultaneously from the suction nozzles without causing empty suction where only air is sucked out, even if any part of the vessel is empty.

[0011]

According to an example of the solution discharge means, an appropriate capacity and resistance are secured between the suction pump and the branch manifold , and further an appropriate capacity is secured between the branch manifold and the suction pipe. If the capacity of spaces between the suction nozzles and each of the branch manifold is made greater than the capacity of the vessel, a negative pressure can be secured in the branch manifold before all the solution in the vessel is sucked out, so that stable suction can be maintained. Further, a proper suction speed can be obtained by securing a suitable resistance between the suction nozzles and the branch manifold.

[0012]

Furthermore, the capacity of the spaces between the branch manifold and the suction pump can absorb a sudden pressure change that is caused when the operation of the suction pump is started or stopped, thereby slowing down the start and stop of the suction by the suction nozzles, thereby preventing the magnetic particles from being discharged from the vessel. The proper suction speed can be also obtained by securing a suitable resistance between the branch manifold and the suction pump.

In order to secure an appropriate capacity and resistance between the branch manifold and the suction pump, pipes or a buffer tank with a proper capacity may be connected between the branch manifold and the suction pump.

[0013]

This invention can comprise all of the aforesaid means including the suction nozzle moving means, magnetic particle holding means, and solution discharge means. In the system for carrying out the process for sucking and discharging a solution from a vessel, it comprises a plurality of suction nozzles, the branch manifold connecting the suction nozzles individually to branch ends by pipes, a suction pump for suction from the suction nozzles through the branch manifold, and liquid conveying means for feeding a liquid into the pipes between the branch manifold and each of the suction nozzles, thereby filling pipes with liquid, support means for supporting suction nozzles movable toward the vessel, suction nozzle moving means including support means for supporting suction nozzles movable toward the vessel and urging means for urging suction nozzle toward the vessel, and magnet particle holding means including magnet and magnet moving means for supporting the magnet so as to be movable toward and away from the vessel.

[0014]

Thus, the suction nozzle moving means can position the distal end of suction nozzle being kept in contact with the inner wall surface of the vessel. In the magnetic particle holding means, the magnet moving means brings magnet toward the vessel, the magnet holds the magnet particle in given position in the vessel, the solution discharge means sucks and discharges simultaneously the solution in the vessel from a plurality of suction nozzle through branch manifold with suction pump.

[0015]

[Embodiment of the Invention]

Hereafter, the embodiment of this invention will be described with reference of figures.

Fig. 1 is a view for illustrating an outline of the construction of a drainage system according to the invention.

A drainage system 1 comprises a plurality of suction nozzles 2, suction nozzle moving means 3 which moves the suction nozzles 2 toward or away from a vessel 6 such as micro-plate assembly, magnetic particle holding means 4 which holds magnetic particles in the vessel, thereby preventing the magnetic particle from being sucked out through the nozzles, and solution discharge means 5 which causes the suction nozzles 2 to suck solution out of vessel and discharge solution into the vessel. The vessel is not limited to the micro-plate assembly, and may alternatively be any other vessel such as a vial that can hold a liquid sample. Magnetic particles for holding an objective substance is put in the vessel.

[0016]

The respective distal ends of the suction nozzles 2 are inserted individually into wells 6a of the micro-plate assembly 6,

whereby a solution such as a liquid sample is sucked or discharged. The suction nozzle moving means 3 can easily move the suction nozzles 2 toward or away from the micro-plate assembly 6 and position the nozzles 2 in the wells 6a.

The suction nozzle moving means 3 includes support means for supporting the suction nozzles 2 for movement toward and away from the micro-plate assembly 6 and urging means, such as a spring, for urging the suction nozzles 2 toward the micro-plate assembly 6. The support means moves the suction nozzles 2 toward the micro-plate assembly 6. Further, the urging means locates the respective distal ends of the suction nozzles 2 individually in given positions in the wells 6a of the micro-plate assembly 6 without controlling the position of the support means after the nozzle ends are brought into contact with the wells 6a.

[0017]

The magnetic particle holding means 4 collects the magnetic particles in the wells 6a of the micro-plate assembly 6 by means of magnetic force and prevents them from being sucked out together with the solution through the suction nozzles 2. The holding means 4 includes magnets 8 arranged opposed to the underside of the micro-plate assembly 6 and a movement mechanism capable of moving the magnets 8 toward and away from the micro-plate assembly 6.

[0018]

The solution discharge means 5 simultaneously sucks and discharges the solution in the micro-plate assembly 6 through the suction nozzles 2. The discharge means 5 includes a branch manifold 5b with branch ends, pipes 5a individually connecting the branch ends and the suction nozzles 2, a suction pump 5c for suction from the suction nozzles 2 through the manifold 5b, and

liquid conveying means (switching valve 5d, conveying pump 5e, cleaning fluid vessel 5f, cleaning fluid 5g, etc.) for feeding the liquid into the pipes 5a to fill them with the liquid.

Since the branch manifold 5b of the solution discharge means 5 is connected with the suction nozzles 2, the liquid can be sucked out by the single suction pump 5c. Further, the pipes 5a that extend between the manifold 5b and the suction nozzles 2 are filled with the liquid by the liquid conveying means. If any of the wells 6a of the micro-plate assembly 6 is empty, therefore, the solution in the wells 6a can be automatically sucked and discharged at the same time through the suction nozzles 2 without causing empty suction in which only air is sucked out.

[0019]

If the capacity of the pipes 5a that connect the branch manifold 5b and the suction nozzles 2 at the branch ends is made larger than the capacity of the vessel, for example, the portion ranging from the branch manifold 5b to the suction pump 5c can be kept under negative pressure, so that the whole of the solution in the vessel can be sucked out with stability. Further, the suction speed can be properly adjusted by subjecting the pipes 5a to an appropriate resistance.

[0020]

A buffer tank 5h can be provided between the switching valve 5d and the suction pump 5c. The buffer tank 5h uses as means for adjusting the capacities and resistances of the portion on the suction side from the branch manifold 5b. The tank 5h has a given capacity and a given resistance such that a sudden pressure change, if any, caused when the operation of the suction pump 5c is started or stopped, can be eased to soften the operation of suction through the suction nozzles 2. If the pump

operation is stopped before all the solution in the vessel is sucked out, in particular, the solution continues to be sucked out under negative pressure in the buffer tank even after the stoppage of the pump operation, so that the vessel can be evacuated. As this is done, the negative pressure lowers with time, so that the suction can be finished gently. Thus, the magnetic particles can be prevented from being sucked out.

The capacities and resistances can be also adjusted by pipes arranged between the branch manifold 5b and the suction pump 5c, in place of the buffer tank 5h.

[0021]

An outline of the operation of the drainage system 1 will now be described with reference to the flowchart of Fig. 2, the views for illustrating the operation of suction nozzles of Fig. 3, the views for illustrating the magnetic particle holding means of Fig. 4, the views for illustrating the suction nozzle moving means of Fig. 5 and Fig. 6, the views for illustrating the suction nozzle of Figs. 7 and 8.

First, in the processes of Steps S1 to S3, the pipes 5a are filled up with the liquid. By doing this, simultaneous suction through the suction nozzles 2 can be carried out without sucking only air even if any of the wells 6a of the micro-plate assembly 6 is empty.

[0022]

The suction nozzle moving means 3 causes the suction nozzles 2 to move to a position at a distance from the micro-plate assembly 6 (Step S1). Then, the switching valve 5d is shifted to connect the branch manifold 5b and the conveying pump 5e (Step S2). The conveying pump 5e sucks the cleaning fluid 5g out of the cleaning fluid vessel 5f, whereupon the pipes 5a between the

branch manifold 5b and the suction nozzles 2 are filled with the cleaning fluid 5g (Step S3).

[0023]

In the process of Step S3, suction nozzles 2a and 2b and the pipes 5a can be shifted from an empty state (Fig. 3(a)) to a state filled with a liquid (Fig. 3(b)). Thus, by filling the suction nozzles 2a and 2b and the pipes 5a with the liquid, as shown in Fig. 3(b), the liquid in the pipes 5a can be sucked even if one of the wells 6a of the micro-plate assembly 6 is empty, as shown in Fig. 3(c). Accordingly, occurrence of a situation where only air is sucked out but liquid in is not sucked out can be avoided. The operation for filling the pipes 5a with the liquid serves also to clean the suction nozzles.

Fig. 3(d) shows a case in which the solution is sucked out while the suction nozzles 2a and 2b and the pipes 5a is empty. If one of the wells 6a is empty, in this case, air is sucked out through it. Unless a pump with a high suction speed is used, therefore, the liquid in the other wells 6a cannot be sucked out. Possibly, this suction speed may be too high to prevent the magnetic particles from being sucked in together with the liquid.

[0024]

Then, the magnetic particle holding means 4 causes the magnets 8 to move toward the underside of the micro-plate assembly 6 (Step S4), whereupon the magnets 8 hold the magnetic particles on the respective inner wall surfaces of the wells 6a of the micro-plate assembly 6.

An example of the magnetic particle holding means 4 will now be described with reference to Figs. 4(a) to 4(c). Figs. 4(a) and 4(b) are a side view and a front view, respectively, with the magnets kept away from the micro-plate assembly. Figs. 4(c) and

4(d) are a side view and a front view, respectively, with the magnets situated close to the micro-plate assembly.

[0025]

The magnetic particle means 4 includes the second support plate 4e which is supported vertically movable by an eccentric cam 4i on the base 4g and a plurality of support posts 4f, and a first support plate 4a which is supported on the second support plate 4e movable toward and away with a spring 4c.

The eccentric cam 4i is rotated by a motor 4h that is fixed on the base 4g. The rotation of the eccentric cam 4i causes a bearing 4j and a support member 4k to move toward and away from the micro-plate assembly 6 (in the vertical direction in Fig. 4). A plurality of support post 4f support the second support plate 4e movably.

[0026]

The spring 4c is mounted on a shaft 4b fixed on the first support plate 4a, between the first support plate 4a and the second support plate 4e. The spring 4c moves toward and away from the micro-plate assembly 6 (in a vertical direction in Fig. 4). On the other hand, the shaft 4b is mounted on a shaft holder 4d fixed on the second support plate 4e. The shaft 4b can slide against the shaft holder 4d. Alternatively, the shaft 4b and the shaft holder 4d may be attached to the second and first support plates 4e and 4a, respectively.

[0027]

When the second support plate 4e is moved to its lower position as the eccentric cam 4i rotates, the first support plate 4a is also moved to its lower position, which is off the undersurface of the micro-plate assembly 6. If the eccentric cam 4i further rotates to raise the second support plate 4e, on the

other hand, the first support plate 4a is also raised by the spring 4c and situated close to the undersurface of the micro-plate assembly 6. In this state, the magnets 8 are situated individually in recesses 6d in the undersurface of the micro-plate assembly 6. Thereupon, the magnetic particles in the wells 6a are attracted to the magnets 8 and collected.

Figs. 5 shows a state in which magnetic particles are collected on the inner wall surface of a bottom portion 6b of one of the wells 6a by the magnet.

[0028]

If the second support plate 4e is further raised after the distance between the first and second support plates 4a and 4e is adjusted so that the plate 4a is brought into contact with bases 6c of the micro-plate assembly 6, the spring 4c contracts to absorb the ascent of the second support plate 4e (Figs. 4(c) and 4(d)). Thus, each magnet 8 can be located on the base 6c in each corresponding recess 6d of the micro-plate assembly 6 as the spring 4c contracts without controlling the position of the second support plate 4e or the like (Step S5).

[0029]

Then, the suction nozzle moving means 3 causes the suction nozzles 2 to move to the wells 6a of the micro-plate assembly 6. Fig. 5 and Fig. 6 show two examples of the suction nozzle moving means 3.

In suction nozzle moving means 3A that is shown in Fig. 5, a suction nozzle 2 is slidably supported by a guide 3c, and is urged toward the micro-plate assembly 6 through a collar 3b by a spring 3a.

In suction nozzle moving means 3B that is shown in Fig. 6, a suction nozzle 2 is slidably supported by a guide 3c, and is

urged toward the micro-plate assembly 6 through a collar 3b by a weight 3d.

In the description of the present embodiment to follow, the suction nozzle moving means 3 shown in Fig. 5 are regarded as the suction nozzle moving means 3A (Step S6).

[0030]

When the suction nozzle moving means 3 is moved toward the micro-plate assembly 6, the suction nozzle 2 moves toward the micro-plate assembly 6 side, a distal end 2A of the suction nozzle 2 approaches its corresponding well 6a of the micro-plate assembly 6 and abuts against the inner wall surface of the bottom portion 6b of the well 6a.

If the suction nozzle moving means 3 is further moved toward the micro-plate assembly 6, the spring 3a absorbs this extra movement, so that the contact of the distal end 2A of the suction nozzle 2 with the bottom portion 6b can be maintained. Thus, the suction nozzle 2 can be easily positioned with respect to the micro-plate assembly 6 without subjecting the suction nozzle moving means 3 to any special position control(Step S7).

[0031]

Then, the switching valve 5d is shifted to connect the branch manifold 5b and the suction pump 5c or the buffer tank 5h (Step S8), and the suction pump 5c sucks the solution out of the wells 6a of the micro-plate assembly 6. During this suction, the cleaning fluid with which the pipes 5a are filled in advance are first sucked out, and at the same time, the solution in the wells 6a is sucked into the pipes 5a. During the suction, moreover, magnetic particles 7 in the wells 6a are collected and held by the magnets 8, and the solution can be sucked out at low suction speed as the pipes 5a are filled with the liquid. Thus, the magnetic

particles 7 cannot be discharged by the suction by the suction nozzles 2.

If the capacity of the micro-plate assembly 6 is greater than that of the pipes 5a so that the pipes 5a are evacuated to cause the efficiency of suction through the other suction nozzles to lower during the suction, this suction efficiency can be increased by repeatedly filling the pipes 5a with the liquid in the aforesaid processes of Steps S1 to S3 (Step S9).

[0032]

After the suction is finished, each suction nozzle 2 are separated from the micro-plate assembly 6 by the suction nozzle moving means 3. As this is done, the suction nozzle 2 is returned by the urging force of the spring 3a and located in its initial position by the collar 3b (Step S10).

The switching valve 5d is shifted to connect the branch manifold 5b and the conveying pump 5e (Step S11), and the cleaning fluid 5g in the cleaning fluid vessel 5f is fed into the pipes 5a and the suction nozzles 2 by the pump 5e, whereby the pipes 5a and the nozzles 2 are cleaned (Step S12).

[0033]

Fig. 7 shows an example of one suction nozzle 2. The distal end portion 2A of Fig. 1 has a slanting shape. The slope of the distal end portion 2A of the nozzle 2 prevents the opening of the end portion 2A from being closed even if the end portion 2A touches the bottom portion of its corresponding well 6a.

Fig 8 shows a plurality of suction nozzles 2. In Fig. 8, the plurality of suction nozzles are arranged with suction nozzle moving means 3 connected to one another. If the positions (heights) of the respective distal end portions of the nozzles 2

with respect to the micro-plate assembly 6 are not equal, according to this arrangement, the support means and the urging means of the suction nozzle moving means 3 can satisfactorily bring the nozzle end portions into contact with the wells 6a without requiring any special position control.

[0034]

If the conveying pump is a constant delivery pump, a reagent can be injected through each suction nozzle at a fixed rate. Even in the case where a plurality of suction nozzles are arranged the reagent can be distributed in desired ratios to a plurality of vessel by adjusting the respective resistances of the branch manifold 5b and the pipes 5a.

[0035]

According to the embodiment of the present invention, the suction nozzle moving means, magnetic particle holding means, solution discharge means, or combinations of these means can be used easily to carry out suction and discharge without requiring any special control for positioning.

Further, the solution can be sucked and discharged simultaneously through a plurality of suction nozzles, and these nozzles can be cleaned simultaneously.

[0036]

[Effect of the Invention]

According to the drainage system of the present invention, as described herein, processes for suction, discharge, separation, etc. can be carried out with use of a simple mechanism.

[Brief Description of the Drawings]

[Fig. 1]

It is a view for illustrating an outline of the construction of a drainage system according to the present

invention.

[Fig. 2]

It is a flowchart for illustrating the operation of the drainage system of this invention.

[Fig. 3]

Those are views for illustrating the operation of suction nozzles of the drainage system of this invention.

[Fig. 4]

Those are views for magnetic particle holding means of the drainage system of this invention.

[Fig. 5]

Those are views for suction nozzle moving means of this invention.

[Fig. 6]

Those are views for suction nozzle moving means of this invention.

[Fig. 7]

It is a view for suction nozzle of this invention.

[Fig. 8]

Those are views for suction nozzles of this invention.

[Description of Notations]

1 … drainage system

2,2a,2b … suction nozzle

2A … distal end

3,3A,3B … suction nozzle moving means

3a … spring

3b … collar

3c … guide

3d … weight

4 ··· magnet particle holding means

4a ··· first support plate

4b ··· shaft

4c ··· spring

4d ··· shaft holder

4e ··· second support plate

4f ··· support post

4g ··· base

4h ··· motor

4i ··· eccentric cam

4j ··· bearing

4k ··· support member

5 ··· solution discharge means

5a ··· pipes

5b ··· branch manifold

5c ··· suction pump

5d ··· switching valve

5e ··· conveying pump

5f ··· cleaning fluid vessel

5g ··· cleaning fluid

5h ··· buffer tank

6 ··· micro-plate assembly

6a ··· well

6b ··· bottom portion

6c ··· base

6d ··· recess

7 ··· magnetic particle

8 ··· magnets

[Abstract]

[Problem to be solved]

Automatically, carrying out process for suction, discharge, and solution by a simple mechanism.

[Solution]

In a system for sucking and discharging a solution from a vessel (micro-plate assembly 6) by suction nozzles 2, processes for suction, discharge, separation, etc. can be carried out with use of a simple mechanism, including suction nozzle moving means 3 for positioning the respective distal ends of the suction nozzles on the inner wall surface of the vessel, magnetic particle holding means 4 for magnetic particles 7 in a given position in the vessel, and solution discharge means 5 for sucking out and discharging the solution simultaneously from the vessel through the suction nozzles. Each or a combination of these means constitutes a drainage system.

Fig. 1

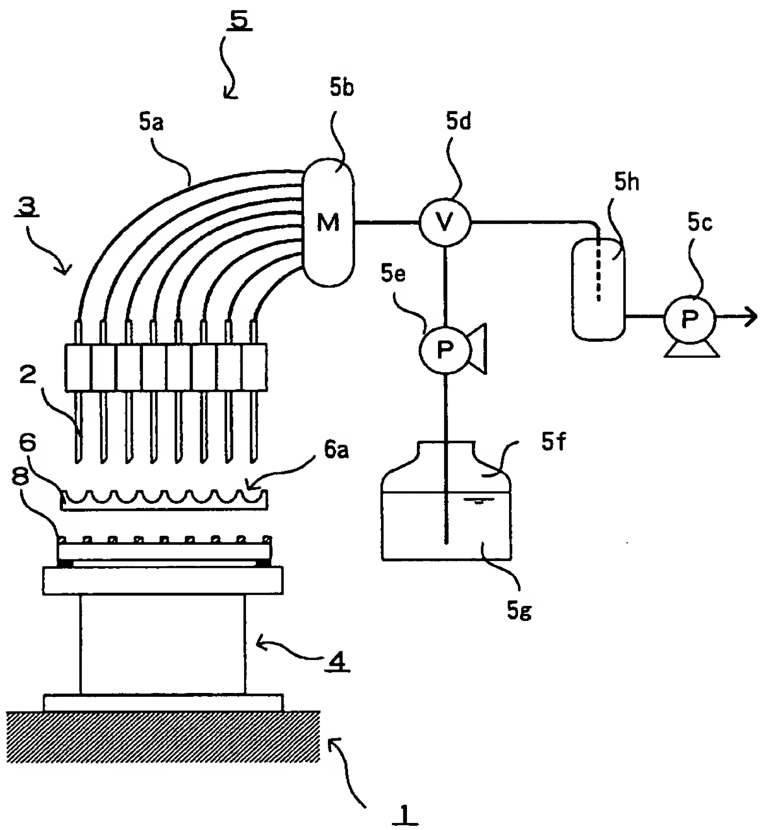

Fig. 2

START

S1 SEPARATE SUCTION NOZZLES FROM MICRO-PLATE ASSEMBLY BY SUCTION NOZZLE MOVING MEANS

S2 SHIFT SWITCHING VALVE TO CONNECT BRANCH MANIFOLD AND CONVEYING PUMP

S3 SUCK CLEANING FLUID BY CONVEYING PUMP AND FILL PORTIONS BETWEEN BRANCH MANIFOLD AND SUCTION NOZZLES WITH CLEANING FLUID

S4 ATTACH MAGNET TO LOWER SURFACE OF MICRO-PLATE ASSEMBLY BY MAGNET MOVING MEANS

S5 HOLD MAGNETIC PARTICLES ON INNER WALL SURFACES OF WELLS OF MICRO-PLATE ASSEMBLY BY MAGNET

S6 MOVE SUCTION NOZZLES TOWARD MICRO-PLATE ASSEMBLY BY SUCTION NOZZLE MOVING MEANS

S7 RUN DISTAL ENDS OF SUCTION NOZZLES AGAINST BOTTOM PORTIONS OF WELLS OF MICRO-PLATE ASSEMBLY

S8 SHIFT SWITCHING VALVE TO CONNECT BRANCH MANIFOLD AND BUFFER TANK

S9 SUCK SOLUTION OUT OF WELLS OF MICRO-PLATE ASSEMBLY BY SUCTION PUMP

S10 SEPARATE SUCTION NOZZLES FROM MICRO-PLATE ASSEMBLY BY SUCTION NOZZLE MOVING MEANS

S11 SHIFT SWITCHING VALVE TO CONNECT BRANCH MANIFOLD AND CONVEYING PUMP

S12 SUCK CLEANING FLUID BY CONVEYING PUMP AND CLEAN PORTIONS BETWEEN BRANCH MANIFOLD AND SUCTION NOZZLES WITH CLEANING FLUID

END

Fig 3

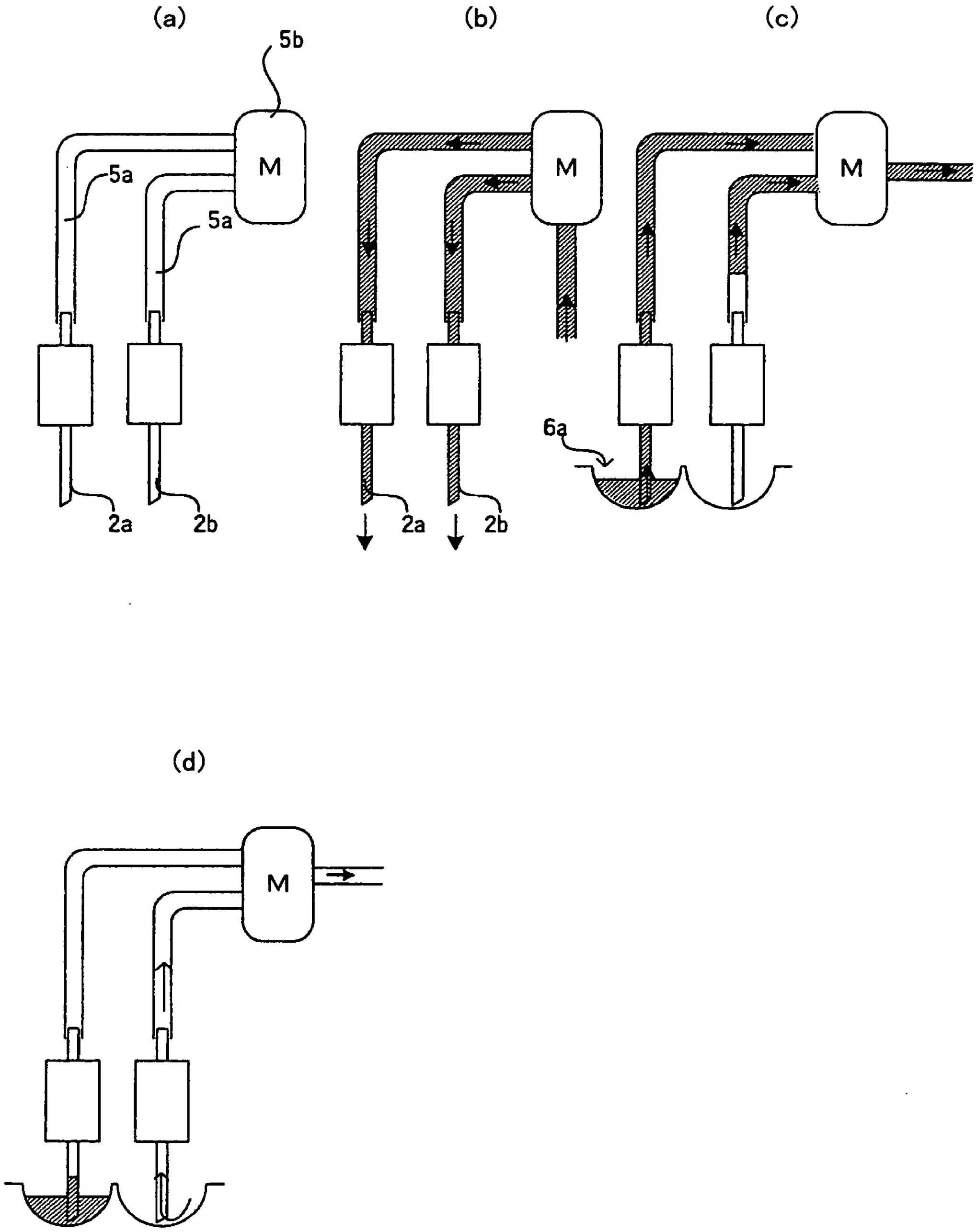

Fig. 4

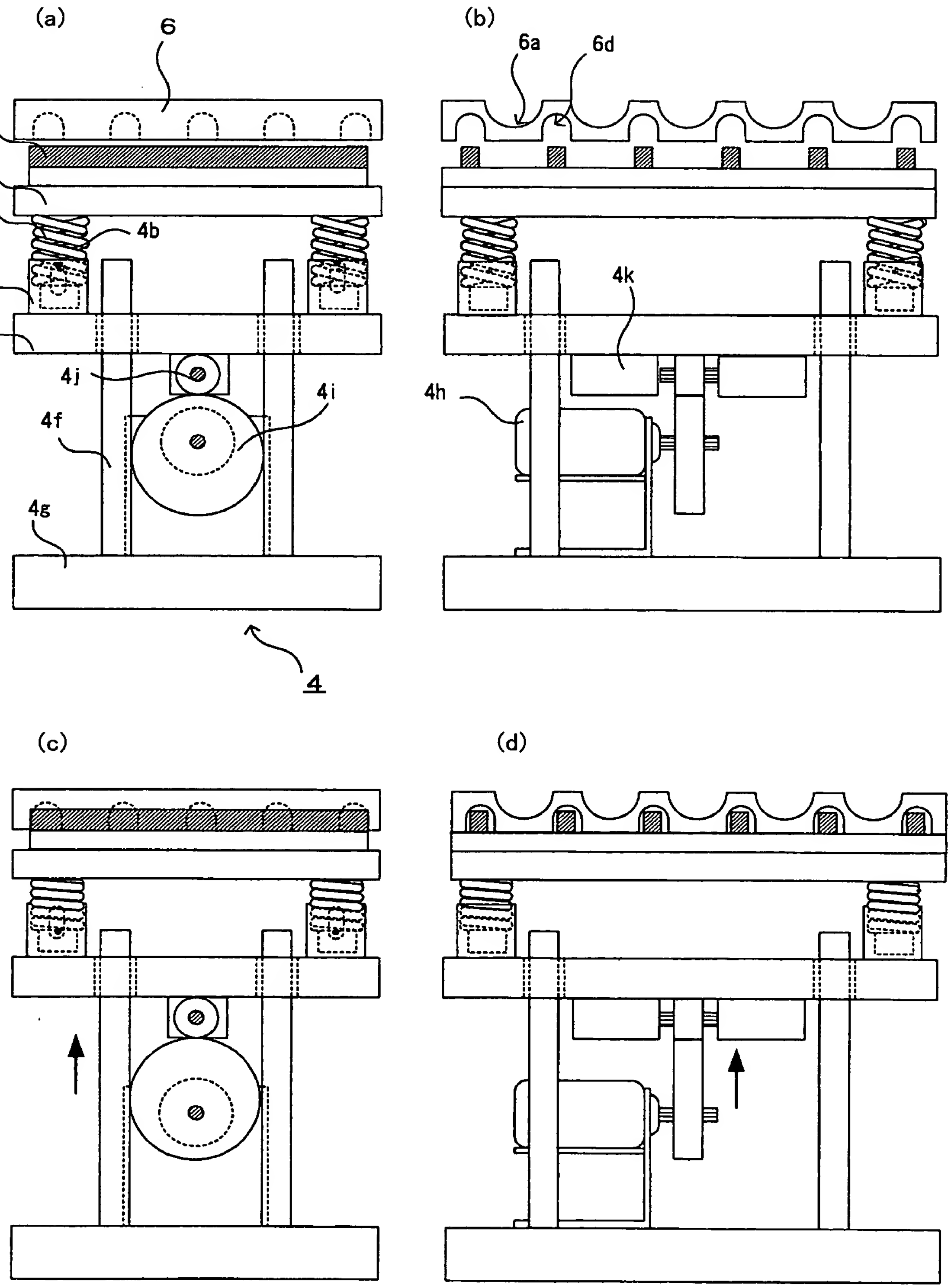

Fig. 5

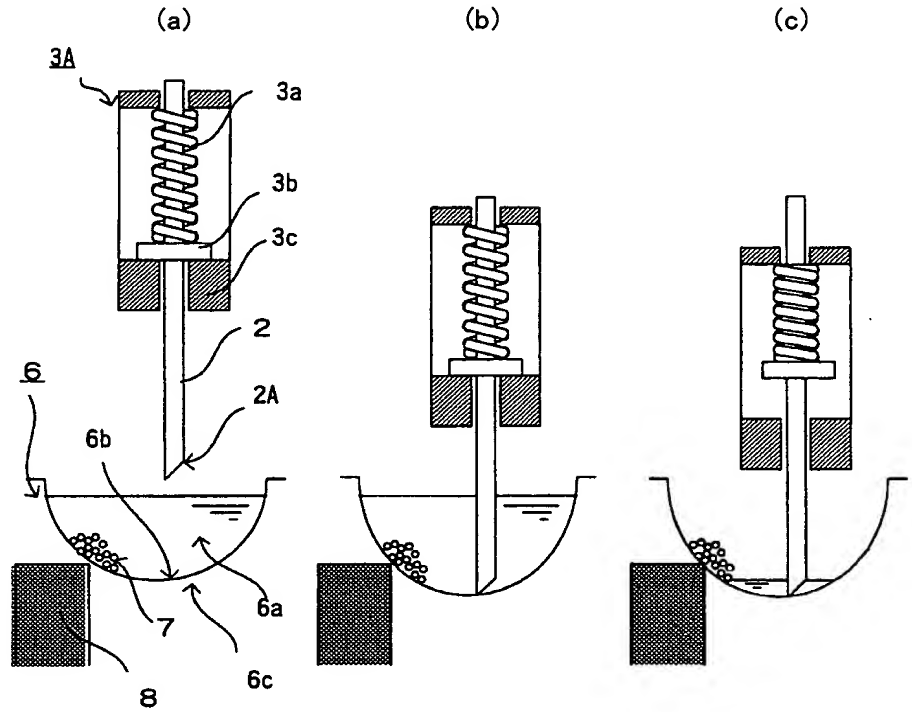

Fig. 6

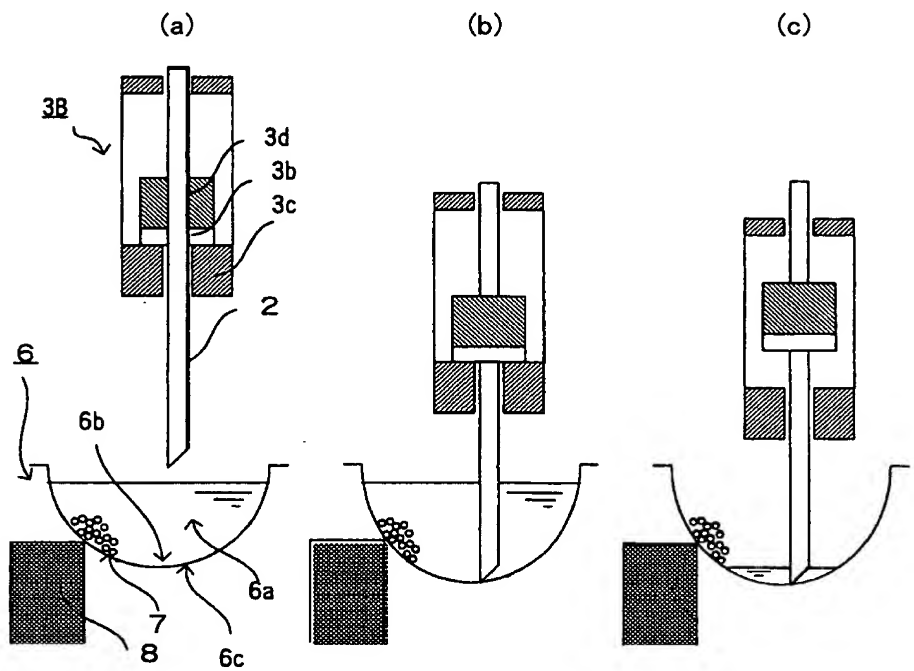

Fig. 7

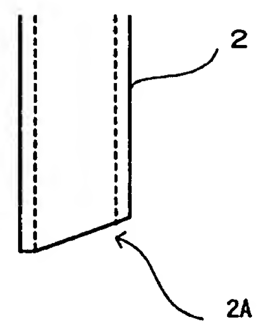

Fig. 8

(a)

(b)